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**SCIENCE AND TECHNOLOGY**

**No. 39**



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CHINA REPORT  
SCIENCE AND TECHNOLOGY  
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## NATIONAL DEVELOPMENTS

### RESEARCH INSTITUTES WANT FREEDOM TO MANAGE THEIR OWN PERSONNEL, FUNDS

Beijing GUANGMING RIBAO in Chinese 27 Apr 80 p 2

[Article by Liang Heng [2733 5899]: Research Institutes Must Have Freedom To Manage Their Own Personnel and Funds and Choose Own Topics; Conference of Regional Research Institutes To Exchange Experience Held in Shanxi"]

[Text] The Shanxi provincial science committee recently held a working conference attended by representatives from over 110 research institutes and eight higher educational institutions. They discussed reorganization and building of specialized research institutes and especially the problem of expanding the autonomy of regional research institutes.

Comrades attending the conference believe efforts should be made to give more life to regional scientific research institutes so that they can develop their own specialty according to their own special characteristics, and in this way, they can possess definite conditions for independent management and autonomous development and gradually change from complete dependence upon the state's investment to units combining state investment and funds solicited by themselves. The conference proposed, based on many years of practice, that at present special emphasis should be placed on expanding the autonomy of research institutes concerning personnel, finances and topics of study.

1. Each research institute should have the authority to select, hire or refuse to accept personnel assigned to the institute. The institute should have the authority within its own premises to use, examine, promote or fire cadres. Scientific and technical workers who have made outstanding contributions should be given special promotion. The institutes should have the authority, according to operational need, to invite or accept scientific and technical personnel from outside units to come and conduct short-term scientific research. The leading departments of the upper echelons or individuals should not force the institute to accept people that the institute does not need and people who are not qualified for the job.

2. Each research institute, after completing a scientific research project, should have the authority to seek its own means and open its own source of



funding and increase its income. Subsidiary plants of research institutes and intermediate testing shops should be allowed to proceed with small scale production and sale of products that have been developed in scientific research and have been trial produced. The income of the institutes should not have to be submitted to the higher financial authorities. The entire income should remain within the institutes as funds for scientific research, collective welfare benefits and funds for rewards. The institutes should have the authority to manage and utilize these funds. The higher authorities should not reduce appropriations for scientific research to units that actively open up financial sources and increase income. The higher authorities should not transfer resources indiscriminately or utilize funds the institute had solicited by itself.

3. Each institute after being assured that the state's scientific research tasks have been completed, should be able to select scientific research subjects which will create short term benefits or increase income according to the institute's own manpower, material resources and financial resources. The institutes should also be able to accept scientific research assignments from production units and other units.

9296

CSO: 4008

## NATIONAL DEVELOPMENTS

### LOGISTICS WORK OF MACHINE BUILDING MINISTRY PLANNING INSTITUTE PRAISED

Beijing GUANGMING RIBAO in Chinese 27 Apr 80 p 2

[Article by Wang Xingzhong [3769 5281 0022]: "Fourth Planning Institute of the Second Ministry of Machine Building Does Good Logistics Work To Eliminate Later Worries of Designers and Scientific Researchers"]

[Text] The logistics department of the Fourth Planning Institute of the Second Ministry of Machine Building has thought of ways to eliminate later worries of designers and scientific researchers to make sure they can concentrate all efforts in doing the work of designing and scientific research well for the four modernizations. These efforts have been welcomed by all.

Delivering the requisitions to the door. In the past the equipment needed by the designers and scientific researchers and the coal used for heating in winter had to be requisitioned by themselves or built by themselves. This wasted a lot of their time. Since last year, the logistics department changed the procedure and delivered the requisitions to where design and scientific research work was being done and the requisitions were delivered as they were ordered. In only one year's time, requisitions were delivered over 200 times, a total of over 3,300 pieces of equipment and over 20 tons of coal for heating and over 18,000 jin of charcoal were delivered.

Delivering medical service and medicine to the door. To assure the health of designers and scientific researchers, to make sure that they go to work often and to eliminate absenteeism, medical personnel were dispatched to provide medical services, deliver medicine and give injections. The service was provided door to door. Last year alone, medical personnel visited the design offices, laboratories and shops a total of over 3,000 times to provide medical services. They treated over 900 persons, and set up 53 sick beds in families so that diagnosis and treatment of disease were all done without the patient going anywhere.

Buying travel tickets, mailing information and packages. In the past, design and scientific research personnel who had to go to the design and construction sites to conduct surveys and research had to collect information, buy travel tickets and mail packages by themselves. Now, the logistics department has

set up a special staff to buy travel tickets and mail packages for them. Last year alone, the staff bought over 3,100 tickets for the design and scientific research personnel and helped mail over 2,000 packages. Persons on assignment were assigned cars to pick them up day and night.

Providing kindergarten services well. All children are taken care of by the day care kindergarten from the time they are 56 days old to the time they enter school. They are picked up and sent home. Since last year, children of parents one of whom is working on out-of-town assignments were picked up and sent home by the kindergarten. The young children are given three meals and one snack a day. The menu is planned by a full time public health doctor to make sure the children are sufficiently nourished and are healthy. The kindergarten provides rich and varied educational, cultural and physical education activities. Nursery and teaching personnel carefully perform their duties and parents are satisfied.

Managing the mess hall well. The mess hall provides over 12 main courses. Noodles and Chinese buns are provided every day and lunch and dinner all have over four different dishes. After eight kinds of sideline foods rose in price, mess hall workers calculated carefully and operated carefully to cut down waste, reduce the cost of meals and prices for main courses did not rise and prices for sideline foods rose only slightly. The mess hall's management became better and better and everyone is more satisfied.

Logistics work is systematized. Under the support concerned departments, the institute has stores selling daily commodities, sideline foodstuff, grains and edible oil, meat and rice, a bath hall and noodle processing unit. Staff and workers of the institute need not leave the institute for any daily necessities.

9296

CSO: 4008



## APPLIED SCIENCES

### SPACE MATERIAL RECOVERED FROM DEPTHS OF OCEAN

Beijing GUANGMING RIBAO in Chinese 29 Apr 80 p 1

[Article: "Our Country Recovers Space Material From Ocean for First Time"]

[Text] Scientific research personnel of the No 1 Oceanographic Institute of the State Maritime Office engaged in mineralogical research on sediment samples brought back from the Pacific sea bottom at a depth of over 4,000 meters discovered mineral spherules containing iron and glass. Initial investigation indicates that they came from outer space.

These minerals were obtained from the depths of the sea last year by this country's scientific research personnel participating in a worldwide atmospheric surveying movement; this is our country's first such find.

Under the microscope, these two space minerals consist of several spherical particles. The iron spherules are all strongly magnetic. When a particle is broken in half it can be seen that it consists of a nucleus and an external shell. The components of the nucleus are primarily metallic iron and nickel, whereas the shell consists primarily of magnetic iron minerals. The glass spherules consist primarily of silicate minerals. In addition, the two types of particles also contain some rare earth and radioactive elements.

Following their analysis, scientific research personnel believe that the space minerals are fragments of planets and other interstellar matter produced in collisions which are continuously moving through space. These fragments, falling to earth, enter the atmosphere, atmospheric friction causes them to melt and continue falling toward the earth, and they ultimately contract into spherules and drop to the ground or into the sea. These outer-space minerals from the sea bottom have furnished our country additional types of samples of space material other than meteorites and lunar samples. They are particularly valuable to our country's ocean sedimentology and space science.

8480

CSO: 4008

NEW THEORY FOR MATHEMATICAL LOFTING OF SHIP HULLS

Beijing GUANGMING RIBAO in Chinese 27 Mar 80 p 2

[Article by Wang Zhaojie [3769 2507 2638]: "Shandong University Mathematics Department Professor Xie Litong and Four Instructors Study 'Roundabout Alignment Method' as New Theory for Mathematical Lofting of Ship Hulls"]

[Text] Shandong University Mathematics Department Professor Xie Litong [6200 0500 0681] and four instructors have proposed, on the basis of summarizing actual experiences in shipbuilding, a new theory for lofting in shipbuilding called the "roundabout alignment method." Using this theory, they prepared a computer program for mathematical lofting of a ship's hull, which was formally used in production at Shanghai's Hudong Shipyard in 1979, in a first step toward our country's formation of a shipbuilding numerical control system possessing our own characteristics.

Countries with advanced shipbuilding technology began in the 1960's to apply computer technology to the shipbuilding industry. Each of these countries came out with its own mathematical lofting theories to form their own shipbuilding numerical control system. Beginning in the 1970's, some units in our country introduced foreign methods, but because shipbuilding technologies were not compatible, quite a few difficulties were encountered. In order to solve these problems, Professor Xie Litong and four instructors worked together with the Shanghai Hudong Shipyard. On the basis of the state of shipbuilding technology in China, they began in 1974 to study mathematical lofting of ship hulls to create a complete and new theory of mathematical lofting for ship hulls--the roundabout alignment method. On the basis of new methods for mathematical lofting of ship hulls established by these theories, they better summarized the practices of manual lofting, and the curved lines that were drawn completely satisfied requirements for hull smoothness, thereby assuring fidelity to the original design drawing in accordance with requirements of shipbuilding technology.

The Shanghai Hudong Shipyard conducted a summary on the 1979 formal use in production of the "roundabout alignment method" using computer programming for mathematical lofting of ship hulls, deciding that it has the following technical and economic advantages: 1) it holds possibilities for the automation of shipbuilding processes using huge single piece production;

2) precision of ship hull parts greatly exceeds those of manual lofting, completely meeting the requirements of shipbuilding and improving quality of shipbuilding; 3) has improved efficiency by more than 100 percent over manual lofting, has made numerical control cutting practical and has shortened overall ship construction time; 4) has greatly reduced or eradicated a second trimming at the time of installation of equipment for a saving in steel, lumber, welding rods, oxygen and other such shipbuilding materials; and 5) all major and basic numerical control data and information are completely centralized and stored within the computer to provide data for enterprise management.

9432

CSO: 4008

## APPLIED SCIENCES

### HIGH-SPEED ION EXCHANGE SPECTROMETER TEST MANUFACTURED

Beijing GUANGMING RIBAO in Chinese 27 Mar 80 p 2

[Text] The first high-speed ion exchange spectrometer ever researched and designed in our country has been successfully test manufactured by the Lanzhou Institute of Chemical Physics of the Chinese Academy of Sciences and the Sichuan Analytical Instruments Plant of the State Bureau of Instruments. Recently relevant organizations evaluated the principal performance criteria of this new device as approaching or attaining foreign levels for the same type instrument, finalizing the design and putting it into production. Liquid phase chromatography is a separation and analytical technique with prospects for wide applications that has arisen during the past 10 years. Ion exchange spectrometry is foremost of four liquid phase chromatographic separation and analytical methods. It can conduct effect separation of any chemical compound in solution that can dissociate into ions, and it can solve the problems of low separation speeds, weak ion capacity, and difficulties in quantification existing in classic ion exchange spectrometry, which pose great significance for inorganic ion analysis. Following investigation and study by the Lanzhou Institute of Chemical Physics of the Chinese Academy of Sciences, a high-speed spectrographic Coulomb discriminator and a C-type plunger pump began to be test manufactured, and after 2 years of arduous struggle success was finally achieved in the test manufacture of a high speed ion exchange spectrometer simulator.

9432

CSO: 4008

'RENNIN RIBAO' COMMENTS ON MERITS OF GEOLOGICAL WORKERS

HK030442 Beijing RENMIN RIBAO in Chinese 16 Apr 80 p 1

[Editorial: "Learn From the Geological Workers' Pioneering Spirit"]

[Text] "Walking 1,000 li wearing out iron shoes; opening up new vistas by knocking at the door of the great earth." This is an apt description of the heroic model workers on the geological front. Geological workers who work all year round in remote mountains and barren deserts, open countries, seas and oceans; their work requires constant mobility and moving from place to place and they work under harsh conditions. They have made contributions to the people. With the approval of the State Council, the Ministry of Geology held an award presenting ceremony on 14 April to commend their heroic deeds.

We can be proud of the fact that a group of geological workers who are daring in exploring and experimenting and who have attained new knowledge and achieved new breakthroughs has emerged on the geological front. It is an honor for the geological front, and the Chinese race as well, to have a world famous scientist like Comrade Li Siguang.

The broad masses of workers on various fronts should learn from the geological workers' spirit of doing pioneering work through arduous efforts. The footprints of their arduous labor, the sweat and blood of their hard work have left their marks everywhere in the deep ravines, in the thick forests, on the snow lines, on the Gobi sand banks and on islands. They have provided the motherland with a great amount of dependable geological data and abundant mineral resources, thereby basically guaranteeing that needs for socialist construction may be met.

Rich mineral resources are very precious wealth of our country. They are an important material prerequisite for the four modernizations. A clear knowledge of geological conditions and thorough exploration of mineral resources must invariably precede any agricultural development, light industry extraction of petroleum and coal, building of railways and sea ports, construction of irrigation projects and construction of ferrous metal, non-ferrous metal, rare metal and nonmetal mines. Taking geological exploration work for petroleum as an example, in the middle of 1950's geological departments strengthened the general survey for petroleum and achieved a series of



breakthroughs, thereby providing rich resources for the rapid development of the petroleum industry. It was precisely upon the proposal of Comrade Li Siguang that petroleum exploration teams of the geological establishment set off to northern China, Songliao and other sedimentary basins. The prospecting group headed by Comrade Han Jingxing was able to write a general geological survey report on petroleum. The geological workers struggled with the blue sky as their cover, the grassland under their feet and in severe cold weather to determine the Daqing-Changtan structure. This laid down the conditions for the development of the Taqing oilfields. Later, work on petroleum exploration weakened. This affected not only the continuous development of the petroleum industry, but also the development of the entire national economy. It is precisely in this sense that we say geological work is the foundation of construction under the four modernizations. It occupies a strategic position in the development of the national economy.

At present, although geological work has attained great achievements, it still has to strive harder to meet the requirements of the four modernizations and the people's needs. We must realize that geological work is still a weak link in the national economy. The level of technology and quality of equipment and management is still backward. Many mineral resources do not have clear prospects for the future and some badly-needed minerals are in short supply or do not have ample deposits. For geological work to be a good trailblazer, it must constantly analyze the conditions of the distribution of resources and keep abreast of the needs for mineral raw materials in the four modernizations. It must fulfill the needs of national construction at present while at the same time consider the needs of long-term construction. It must do a good job of predicting and quantitatively estimating prospective mineral deposits and various types of mineral resources, and discover and appraise more mineral-producing areas. It takes a rather long period from the discovery of a mine and its prospecting to the start of production to supply construction work. Therefore, geological work must be done first. This is an objective law of economic construction.

To build an army of geological workers who are both red and expert, the role of scientific and technological personnel must be brought into full play. Those administering geological work should place special emphasis on the study of professional skills in geology. They must know the peculiarities of geological work and try to become professionals from being nonprofessionals. Many comrades have become, or are becoming, professionals from being nonprofessionals. Practice has shown that it is not totally impossible for a nonprofessional to become a professional. Geological work constantly involves arduous and complex mental and physical labor. Scientific and technological personnel play a leading role in geological work. Fully mobilizing the enthusiasm of technical personnel, bringing their role into full play and giving them real responsibilities and power are the decisive factors for doing geological work well. Party leadership at all levels must continue to implement the party's policy on intellectuals, have a correct understanding of the important position and function of technical personnel in geological work, bring their strong points and expertise into full play and try as much as possible to meet their special needs in work and daily life. All technical personnel must constantly

improve their technical and vocational level, study new techniques and methods in geological science and master modern scientific and technological knowledge to contribute their talents and efforts.

The four modernizations of the motherland places great hopes on geological work. Geological work has broad prospects. The broad masses of geological workers should make the achievements and honors they have so far attained their starting point for continuing on the march to find more and better mines and gain more and better results by all ways and means. They should march on to conquer mother nature from the land, the sea and the sky.

CSO: 4008

## APPLIED SCIENCES

### STATUS OF RESEARCH ON LASER FUSION DETAILED

OW181807 Beijing XINHUA Domestic Service in Chinese 0249 GMT 18 May 80

[Text] Shanghai, 18 May--During the 1980 international conference on lasers, the five academic papers read by our country's laser scientists on the major and latest accomplishments in our country's laser fusion research drew great attention from all countries' laser scientists who attended the conference.

An important topic of scientific research in the world today is initiating and controlling thermonuclear fusion by means of lasers and utilizing in construction the tremendous energy released by fusion. China's exploration of laser fusion is primarily carried out by the Shanghai Institute of Optics and Fine Mechanics of the Chinese Academy of Sciences. Of the five academic reports read at that international laser conference, four were from this institute. On behalf of the institute's nuclear fusion researchers, Deng Ximing, deputy director, and Xu Zhishan, deputy research fellow, of the institute, read the two papers entitled "Research and Development on High Power Laser Systems Used in Nuclear Fusion" and "The Study of the Interaction of Laser Plasma and Target Compression" and reported in detail the major accomplishments achieved in the development of laser fusion research in China.

The other three papers--"Laser-initiated Diffusion in Homogenous and Heterogeneous Plasmas and Harmonic Theory" [Jun Yun He Fei Jun Yun Li Zi Ti Zhong Di Shou Ji San She Yu Xie Bo Li Lun 0971 0542 0735 7236 0971 0542 4583 7180 1311 7555 0022 4104 0649 3423 2414 1410 5280 6168 3134 3810 6158] written by deputy research fellow Tan Weihai and others, "Roentgenodiagnosis of Laser Plasma" [Ji Guang Deng Li Zi Ti X Guang Xian Pu Zhen Duan 3423 0342 4583 7180 1311 7555 9897 0342 4848 6225 6035 2457] by assistant research fellow Lu Renxiang and others and "Theory on Isolated Quantum" [Guan Yu Gu Li Zi Di Li Lun 7070 0060 1324 0500 1311 4104 3810 6158] by Chen Yachen, lecturer at the Chinese Nuclear Energy Institute--have explored laser fusion from various sides theoretically and practically.

The Shanghai Institute of Optics and Fine Mechanics started its research on laser fusion in 1965. Today it has worked out a six-beam laser fusion device, various kinds of meters, testing instruments and spherical targets, which are indispensable in laser research, and has developed a one-dimension fluid mechanical computer coding procedure [yi wei liu ti dong li xue ji suan ji bian ma cheng xu 0001 4850 3177 7555 0520 0500 1331 6060 4615 2623 4882 4316 4453 1645]. At the same time researchers at the institute

have also achieved significant results in conducting experiments and theoretical studies of heating plasma by lasers. In 1973, they successfully produced neutrons for the first time by heating plasma with a single-beam laser, thus demonstrating the possibility of initiating and controlling nuclear fusion by means of lasers. Later, they carried out hundreds of experiments of heating plasma with multiple laser beams. In April 1977, they observed the initial compression effects of plasma and thus pushed the laser fusion research to a new stage. Since last November they have also begun an overall experiment on multiple-beam sub-millimicro second pulse-width laser heating and compressing plasma [duo lu ya hao wei miao mai kuan di ji guang jia re yu ya suo deng li xi ti di song ti shi yan 1122 6424 0068 3032 1792 4432 9115 1401 4104 3423 0342 0502 3583 5280 1090 4799 4583 7180 1311 7555 4104 4920 7555 1395 7526] and have obtained some physical information from a hollow spherical glass target filled with neon and from a solid spherical target of deuterated polyethylene. So far only a few industrially developed countries in the world today have achieved such progress and accomplishments.

Those who have engaged in laser fusion research at the Shanghai Institute of Optics and Fine Mechanics are a group of relatively young scientists and technicians. Among them, the average age of the nearly 100 researchers engaged in overall research is under 40. The principal apparatus and equipment used in laser fusion research, including the laser systems, high-precision targets, plasma diagnosis equipment, as well as the tiny, hollow, hair-width diameter targets, are all designed and manufactured by some of our country's scientific research units and factories.

CSO: 4008

## APPLIED SCIENCES

### BACKWARDNESS OF CHINESE COMPUTER INDUSTRY ADDRESSED

Beijing GUANGMING RIBAO in Chinese 17 Mar 80 p 2

[Article by Zheng Haining [6774 3189 1337]: "Several Problems Which Need To Be Solved to Develop the Computer Industry"]

[Text] Due to the disruption and sabotage by the "gang of four," China's computers have lagged far behind the advanced world levels in scientific research, production and applications.

In the "outline of the 1978-1985 All-China Plan for the Development of Science and Technology," the development of computer science and technology was listed as one of the eight main points. To meet the needs of four modernizations construction, there must be a major development in China's computer industry.

It is understood that the departments concerned believe that if we are to speed up the development of China's computer industry, the following problems need to be solved:

1. Do not simply stress the technical targets alone. Computers must be developed in all aspects. There is a tendency in computer development and production, to simply stress the operating speed of the principal computer. Due to historical causes, in the initial stage of China's computer development, computers were used mainly for defense-oriented scientific research and scientific and technical calculations. This type of application has high requirements for the performance of principal computers, but comparatively low requirements for external equipment and software. Computer applications have now spread from scientific and technical calculations to processing of large amounts of data on the national economy and management of enterprises. This has expanded and raised the requirements for external equipment and software. However, the thinking of some leadership and scientific and technical personnel has remained at the first stage of computer applications for a long time, stressing simply the operating speed of principal computers and neglecting external equipment and software. Positive evaluations, citations in the newspaper and awards have usually highlighted the operating speed of principal computers,



which has meant that for a long time, external equipment and software could not keep up and principal computers have been restricted in operating at their full efficiency.

From now on, while continuing to pay close attention to principal computers, we must also attach important to work on external equipment and software. Computer design must achieve strong performance, high reliability, completeness in equipment, and ease in maintenance. Priority for computer development and production can be placed on medium-sized, compact and mini-computers urgently needed in all spheres of the national economy. Give major attention to the standardization and seriation of computers, and change as fast as possible the present confusion in types of lasers.

2. Overcome the three weak links. Large-scale integrated circuits, external equipment (especially magnetic disks), and software, are the three weak links of current laser development and production.

Large-scale integrated circuits basically have not come up to standards. China still has no readily commercially available magnetic disk products. The development and production technology of large-scale integrated circuits are complex and the technology involved is wide-ranging. Give full play to the superiority of the socialist system, letting the departments concerned wage coordinated battle and joint assault. Arm one or two institutes with modern technology and equipment for research on external equipment and give them the capability to conduct research and small-scale production on key problems and also to import needed foreign technology as appropriate.

Regarding software, personnel are scarce. Internationally, there are more software personnel than hardware personnel but in China it is just the opposite. Therefore, we should reinforce the fostering and training of personnel engaged in software. While there are not enough programmers for now, we could organize young job seekers at a certain cultural level, to establish "software cooperatives" which would conduct scientific research and could contract out their services to other units. Institutions of higher learning should increase their recruitment of students specializing in software. Where the conditions are right, we should offer training classes in software to meet the urgent needs.

3. Let scientific research units set up intermediate pilot plants. Quite a few computers developed in China are an "only child." Extremely few are mass-produced which is an extremely great waste. Some developmental units have developed excellent prototypes but the production departments have not been able to put them into assembly-line production. One of the causes is that since the developmental units have no intermediate pilot plants, there is no way to perform intermediate tests on the prototypes, improve the manufacturing process, reduce costs, increase reliability, or adapt to production by the industrial sectors. Let the developmental units establish intermediate pilot plants which would undertake intermediate testing and which

could also conduct preliminary small-scale production. Until we do this, we cannot turn the fruits of scientific research into productive forces.

4. Vigorously develop applied research in computers. China's applied research in computers is in a comparatively backward state. Computer applications are narrow, and even absent in quite a few departments. Quite a few units buy computers without knowing how to use them and some even "abandon" them to neglect. Some computers frequently "go hungry" (that is, remain idling). A considerable number of computers available nationwide cannot be put to full use.

From now on, we must emphasize scientific research in computer applications technology and establish a special fully-equipped research system for computer applications. Each research unit must make a rational distribution of labor, coordinate closely with each other, integrate the state pilot projects, make breakthroughs in computer applications technology, gain experience, set good examples, and make computers commonplace and widespread. Every major industrial sector and major region could establish research institutes in a planned manner for computer applications technology. Let us establish a nationwide computer services company that would be responsible for providing all sectors of the national economy with such projects as systems engineering and design for computer applications, selection of complete sets of computers, installation, debugging and maintenance, and software services. The industrial sectors should also have analogous computer services organizations that would contract to provide the applications-oriented departments with needed systems and equipment, transmission and control technology, and assistance and maintenance.

7755

CSO: 4008

DRAG REDUCTION BY POLYMER EJECTION DESCRIBED

Wuxi ZHONGGUO ZAOCHUAN [SHIPBUILDING OF CHINA] in Chinese No 66, Jul 80  
pp 45-57

[Article by Wang Xiliang [3769 6932 5328], Ding Yongxuan [0002 3057 1357],  
Xia Changsheng [1115 7022 3932] and Wang Guiqin [3769 2710 5367]. Foot-  
notes are as published]

[Text] ABSTRACT. Drag reduction experiments and wall concentration measurements were made on a 3.6-m long flat plate and a 5.463-m surface of revolution with slot ejection of drag reduction polymers at Reynolds numbers of  $3.0 \times 10^6$  to  $5.0 \times 10^7$ . The maximum drag reduction values were 45 and 39 percent, respectively.

Self-propulsion and propeller noise measurements were made on a 4.0-m long body of revolution fitted with a 5-blade screw propeller using slot ejection. The test results showed that the thrust decrease factor was slightly increased and the wake fraction decreased. The propeller noise showed a drop of 1 dB in a range from 5 to 40 kHz. This article derives a differential shear stress relationship for a body of revolution with slot ejection, and carries out slot ejection drag reduction calculations for a body of revolution 5.463-m long, obtaining results that are in good agreement with experiment.

1. Introduction

Drag reduction research is currently receiving widespread attention. Two<sup>1,2</sup> international drag reduction conferences have been held in Great Britain, in 1974 and 1977. In 1976, a review of drag reduction problems by White and Hemmings<sup>3</sup> treated some 1,009 articles published on the subject between 1897 and the beginning of 1975, which they surveyed under 20 different categories. At the Second International Drag Reduction Conference, J.W. Hoyt

gave a critical review of 197 articles in 6 different categories which he had collected between 1975 and 1976. These documents and criticisms<sup>1-4</sup> give a good indication of the expansion and recent research status of drag reduction research. Because of its theoretical value and practical application, polymer drag reduction has in recent years developed rapidly and attracted considerable attention in drag reduction investigations. A uniform polymer fluid with a concentration of several or several dozen parts per million can produce a drag reduction of 70 percent in tubular flow on a small object. For relatively large objects (3-5 m), the drag reduction from fluid ejection is about 40 percent. In addition, it is possible to slow cavitation and to decrease flow noise levels. This has produced extensive interest and attention in the fields of fluid mechanics, chemistry, polymer physics, engineering and biomedicine. Investigation of the mechanism of drag reduction and the mechanism of turbulence are closely related, and in particular measurement of near-wall shear flow has already provided helpful data in the investigation of turbulent flow mechanisms. Investigation of the mechanism of drag reduction will also certainly become an important topic in the physics of fluids.

Drag reduction research at present deals primarily with such areas as the drag reduction mechanism, near-wall flow measurement technology, mathematical modeling and calculation, viscochemical characteristics of polymer solutions and their interaction with flows, and applications of drag reduction in various engineering areas.

This article investigates several questions of external flow drag reduction by polymers, focusing on slot ejection external flow drag reduction at high Reynolds numbers. Considerable theoretical and experimental work<sup>5-13</sup> has been done in this field abroad. The present article introduces some results on external flow drag reduction research obtained in the past by the writers.

## 2. Drag Reduction Capabilities of Polyethylene Oxide with a Rotating Disk

The main drag reduction compound which we used was polyethylene oxide (molecular formula  $\text{O}-\text{CH}_2-\text{CH}_2-\text{O}-[\text{CH}_2-\text{CH}_2-\text{O}]_n-\text{CH}_2-\text{CH}_2-$ ); for convenience of reference the main characteristics of the polyethylene oxides used in the experiments and their designations are given in Table 1.

In order to determine the general drag reduction capabilities of polyethylene oxide, the torque of a circular disk rotating in pure water and a uniform solution may be used. Our experimental water tank measured  $1 \times 0.8 \times 0.5\text{m}$ . The disk was 0.2m in diameter and 4mm thick spray-painted aluminum. The torque was measured with a magnetic reluctance dynamometer. When the instrument gave a thrust reading of 25 kg, the torque was 100 kg-cm; the rotational speed was measured by an electrooptical instrument connected to a frequency counter with a decade scaler. The experimental apparatus is shown in Figure 1 [not reproduced].

Table 1. Main Characteristics of Polyethylene Oxide and Designations in This Article

序号 1	内 容 2	在本文章中的代号 3	催化剂 4	聚合过程 5	分子量 6	色 状 7
1		PEO I	氯化钙 8	固相聚合 9	约 0~80 万 10	白 色 块 11
2		PEO II	二乙基锌 12	液相聚合 13	300 万 14	黄 色 块 15
3		PEO III	硼酸 16	液相聚合 13	200 万 17	白 色 块 18

Key:

- |                                 |                                 |
|---------------------------------|---------------------------------|
| 1) Number                       | 10) About 500,000-800,000       |
| 2) Contents                     | 11) White lumps                 |
| 3) Abbreviation in this article | 12) Diethyl zinc, nitromethane  |
| 4) Catalyst                     | 13) Liquid phase polymerization |
| 5) Polymerization conditions    | 14) 3 million                   |
| 6) Molecular weight             | 15) Yellow granules             |
| 7) Color and form               | 16) Boric acid, diethyl zinc    |
| 8) Calcium carbide              | 17) 2 million                   |
| 9) Solid phase polymerization   | 18) White flakes                |



Figure 2. Torque resistance drop for circular disk, polyethylene oxide, drag reduction saturation concentration  
a--PEO I    b--PEO II    c--PEO III

Key:

- |                      |                              |
|----------------------|------------------------------|
| 1) Drag reduction, % | 3) March 1971 experiments    |
| 2) n (rpm)           | 4) December 1976 experiments |



Before the experiment, polyethylene oxide was made up into solutions of from 1,000 to 2,000 ppm, which at the time of the experiment were placed in the water tank and mixed until uniform. The drag reduction curve for the torque of the circular disk rotating in a uniform water solution is shown in Figure 2, where  $n$  is the rotation speed of the disk. The drag reduction saturation concentrations of PEO I, PEO II and PEO III (the minimum concentration of solution corresponding to maximum drag reduction) were 15 ppm, 9 ppm and 9 ppm respectively, corresponding to maximum drag reduction values of 40, 54 and 53 percent.

Aging characteristics over time of the polyethylene oxide drag reduction solution at the drag reduction saturation concentration are shown in Figure 3, from which it can be seen that the aging rate (including mechanical shear degradation during each test) begins rather rapidly and tends to level off.



Figure 3. Aging of PEO drag reduction capability over time

Key: 1) Drag reduction, % 2) Time, days

The characteristics of PEO I, PEO II and PEO III are still inferior to those of WSR-301, and they must be improved.

### 3. Open-Water Screw Propeller Tests and Noise Determination in a Uniform Solution

The screw propeller was selected from the AU5-65 series with a diameter of 0.24 m, a screw pitch of 0.853 and a hub-to-diameter ratio of 0.18. The speed of rotation in the experiment was 750 rps, and a Kempf and Renners R25 strain dynamometer was used to measure thrust and torque. A circular hydrophone was placed 0.3 m below the surface and 0.9 m away from the propeller blade. The curves for the open-water propeller experiment and some of the noise measurements for pure water and a 20 ppm solution are given in Figures 4 and 5.

In the figures,  $f$  is the frequency, and dB is the noise level in decibels. The experimental results show that for this particular propeller, the differences between water and the solution in terms of thrust and torque were extremely small. The small size of the change in the thrust coefficient

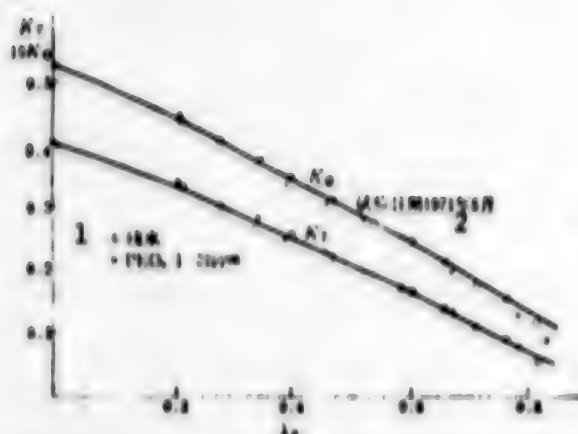


Figure 4. Open-water test curves, screw propeller, pure water and uniform solution

Key: 1) Pure water  
2) May 1971 experiments

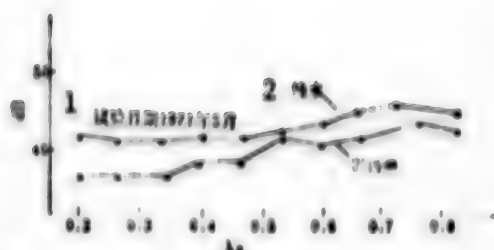


Figure 5. Noise level by frequency, open-water tests of screw propeller with pure water and uniform solution

Key: 1) May 1971 experiments  
2) Pure water

resulted from the sectional characteristics of the screw. The reason that the change in the torque was so small is possibly that the Reynolds number was low or that shape drag was relatively important under the propeller operating conditions. The noise level uniformly dropped 2-4 dB over a frequency range of 5-40 kHz.

#### 4. Experiments on Drag and Self Propulsion of a Model Body of Rotation with Polymer Ejection, and Noise Measurements on a Rear-Mounted Propeller

##### A. Preparation of the Model

The model body of rotation was composed of upper and lower halves with a sealing shell inside. The model was  $L = 4.0$  meters long with a maximum diameter of 0.36 m, and had a parallel middle section from  $3/20 L$  to  $13/20 L$ . The wettable surface area was  $3.5 \text{ m}^2$ . At  $3/40 L$  and  $1/4 L$  from the front of the model were 45 and 61 copper tubes 3.5 mm in diameter inclined at  $30^\circ$  to the surface for ejection of the polymer (see Figure 6). [not reproduced]

The diameter of the screw propeller was 0.193 m; the curves from the open-water tests for the five-bladed screw are given in Figure 7.

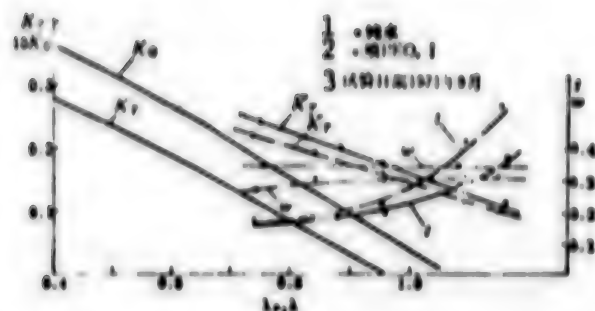


Figure 7. Propeller open-water test curves and self propulsion curves

Key: 1) Pure water  
2) Ejection of PEO I  
3) September 1971 experiments

#### B. Selection of Quantity and Concentration of Ejected Polymer

The materials ejected were the drag reducer PEO I and nanmu extract (produced by soaking nanmu shavings). A front-rear ejection ratio of 1:2 was used<sup>5</sup> in selecting the quantity and concentration of the fluid; results are in Table 2.

Table 2. Drag for Different Ejection Rates and Concentrations

速度 (米/秒) 1	喷射浓度 (ppm) 2	喷射量 (公斤) 3	阻力 (公斤) 4	喷射时阻力 5	$\Delta R$	摩擦阻力 $R_f$ 6	$\Delta R/R_f \times 100$
3.498	1500	0.8	9.00	7.300	1.700	5.70	25.4
		0.8		6.604	2.396		35.8
		1.0		6.545	2.455		38.7
3.548	1000	0.8	9.20	7.160	2.040	6.00	25.4
		0.8		6.935	2.265		35.8
		1.0		6.765	2.435		38.7
3.570	500	0.8	9.25	6.669	2.581	7.00	18.8
		0.8		7.300	1.950		27.9
		1.0		7.270	1.980		29.3

Key:

- |                                |                          |
|--------------------------------|--------------------------|
| 1) Velocity (m/sec)            | 4) Drag (kg)             |
| 2) Ejection concentration, ppm | 5) Drag during ejection  |
| 3) Quantity ejected (kg)       | 6) Frictional drag $R_f$ |

The results show that the optimal rate is 0.8 kg/sec and the optimal concentration 1,000 ppm; unless otherwise stated, the experiments described in this article all use these figures.

### C. Polymer Ejection Drag Reduction Experiments with the Body of Revolution

The experimental speed ranged from 2 to 5 m/sec, and the experiment was conducted (1) in pure water, (2) with ejection of water, and (3) with ejection of solution. When water was ejected at a rate of 0.8 kg/sec, the drag reduction was very small. The results for ejection of water, PEO I and 600 ppm of nanmu extract in the drag reduction tests are shown in Figure 8.

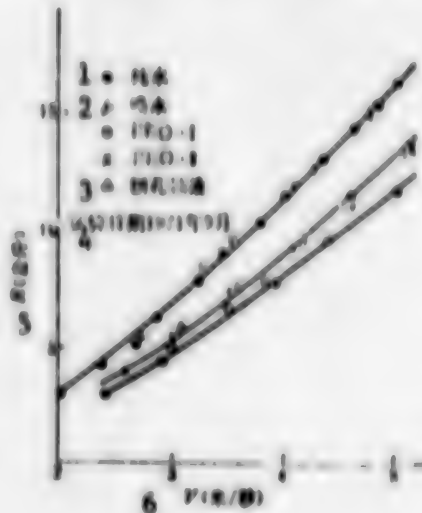


Figure 8. Drag curves for 4.0-, body of ration, pure water, water ejection and fluid ejection

#### Key:

- |                   |                               |
|-------------------|-------------------------------|
| 1) Pure water     | 4) September 1971 experiments |
| 2) Water ejection | 5) R (kg)                     |
| 3) Nanmu extract  | 6) V (m/sec)                  |

The experiments show that the difference in drag reduction for ejection from a single set or a double set of holes and at different rates was not great; see Table 3.

Late in the experiment, cracks began to appear in the surface of the model and some of the ejection liquid leaked out through the seam between the top and bottom; this had no effect on drag in pure water or on drag reduction (curves shown in Figure 9).

Table 3. Change in Drag as Ejection Quantity from Front and Rear Holes is Varied, with Total Quantity Constant

1	2	3	1:1	1:1	1:1	4
2.983		5.58	5.583			5.5
3.953		9.08	9.130			1.5
5.005		13.58	13.540			0.3
7.850		4.48		4.340		1.3
3.451		7.18		7.090		5.7
3.509		7.60		8.095		6.5
4.991		11.40		11.845		3.9
2.754		8.35			8.350	0
3.789		8.48			8.700	3.6

Key:

- 1) V (m/sec)  
2) R (kg)

- 3) Ratio of amounts from front and rear holes  
4) Percent increase

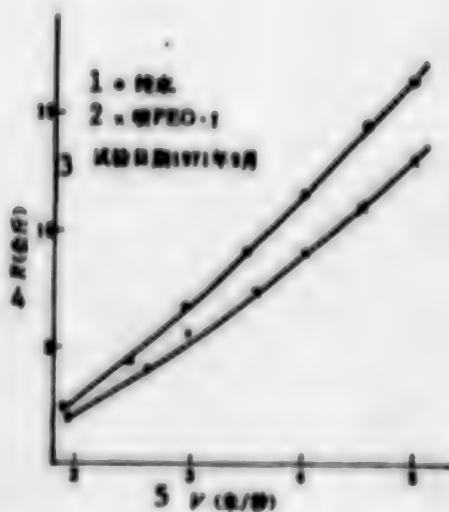


Figure 9. Drag curves for 4.0-m body of rotation after appearance of cracks, pure water and fluid ejection

Key:

- 1) Pure water  
2) Ejection of PEO I

- 3) September 1971 experiments  
4) R (kg)  
5) V (m/sec)



#### D. Self-Propulsion Test in Pure Water and with Fluid Ejection

Four self-propulsion experiments were made at speeds of 2.7-3.5 m/sec for pure water and ejection of nanmu extract. The thrust  $T$ , torque  $Q$ , speed of rotation  $n$  and velocity  $V$  at the self-propulsion points are shown in Figure 10.

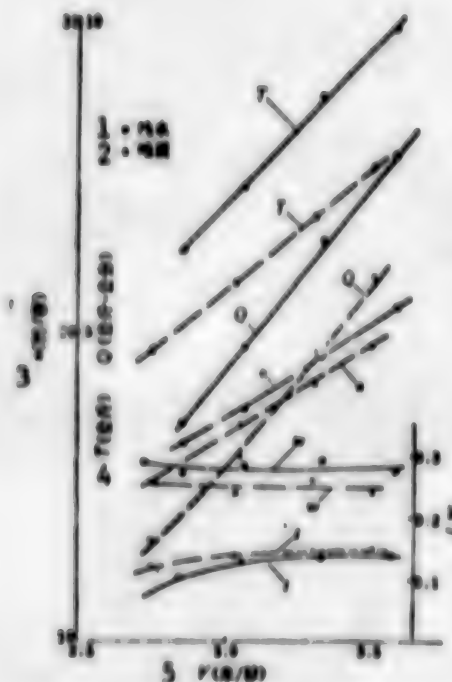


Figure 10. Self-propulsion curves, pure water and fluid ejection

Key:

- |                   |                          |
|-------------------|--------------------------|
| 1) Pure water     | 3) $n$ (rps)             |
| 2) Fluid ejection | 4) $T$ (kg); $Q$ (kg/cm) |
|                   | 5) $V$ (m/sec)           |

The results show that with pure water the thrust reduction  $t$  was 0.14, the wake fraction  $w$  was 0.27 and the torque  $I_2$  was 0.94. For ejection of nanmu extract,  $t = 0.15$ ,  $w = 0.24$  and  $I_2 = 0.96$ . After the cracks had appeared on the body of the model, the stern effect for pure water and for ejection of PEO I were as shown in Figure 7; the change in  $t$  during the self-propulsion process was not large, and the wake fraction fell from 0.35 to 0.31. When the wake fraction was collated by the equal thrust method, it could be seen that the concentration of solution in the wake was very low.

A circular hydrophone was placed 1.5 meters deep in the water and about 0.6 m from the screw and noise measurements were taken for constant speed and constant speed of rotation with both pure water and PEO I. The results (Figure 11) show a drop of 1 dB in propeller noise over a frequency range of 3-40 kHz.



**Key:**

1) Pure water	3) Point number
2) Fluid ejection	4) Frequency $f$

In order to be able to predict drag effects for large bodies of rotation through experiments and theoretical calculations, we carried out slot ejection drag reduction experiments and measurements of the longitudinal distribution of ejection fluid along the wall for a wide range of Reynolds numbers. The drag reduction fluid used was polyethylene oxide with a molecular weight of  $3 \times 10^6$  (PEO II).

## A. General Details of the Experiment

A flat plate and a body of revolution were chosen as models. The flat plate was 3.0 m long and 23 mm thick and during the experiment was 0.336 m deep. Both ends were tapered to an edge, and 0.165 m back from the front there was an ejection slot 0.8 m wide with its surface at a 30° angle. At distances of 0.236, 0.373, 0.681, 1.170, 2.202 and 2.757 m from the front were sample slots 0.25 mm wide with an effective length of about 30-35 mm; 5 of the positions of the sampling slots were the same as in reference 13.

The body of revolution was 5.463 m long and its maximum diameter was 0.267 m, with a wettable area of 4.10 m<sup>2</sup>. At a distance of 0.439 m from the front was a slot 0.8 mm wide inclined at 7°. At distances of 0.454, 0.895, 1.397, 2.199, 2.998, 3.798 and 4.700 m from the front end were circular sampling slots similar to those on the flat plate; the ejection slot and front sampling slots of the body of rotation are shown in Figure 12. [not reproduced]

Sampling was done by suction. The sample size was 0.3 cm<sup>3</sup>/sec-cm. When the speed of the lowest layer of laminar flow was in the linear distribution  $u/v_* = y^+$ , the relationship between the dimensionless lower layer thickness and the flow rate was  $y^+ = (2q/\nu)^{1/2} = 7.7$ . This value is smaller than that for the lower layer in Newtonian flow. In the formula,  $v_* = \sqrt{\tau_w/\rho}$ ,

$\tau_w$  is the shear stress at the wall surface,  $\rho$  is the density,  $y^+ = \frac{v_* y}{\nu}$ ,  $y$  is the normal distance to the wall,  $\nu$  is the dynamic viscosity

coefficient, and  $q$  is the flow rate for unit time and unit length. The turbidity was added 1 ml of 50 percent sulfuric acid solution and 1 ml of 1 percent phosphomolybdic acid solution, the test shaken until the contents were mixed, then let stand for 10 minutes, after which a Model 72 spectrophotometer was used to determine the optical density. The drag reducing substance used was PEO II with an ejection concentration of 500 ppm; the flow rate for the flat plate was 1.0 kg/sec and that for the body of rotation 0.74 kg/sec.

## B. Experimental Results

Figures 13 and 14 show the results of slot ejection experiments for the flat plate and the body of rotation; the Reynolds numbers in the tests were  $3 \times 10^6 - 2.7 \times 10^7$  and  $5.5 \times 10^6 - 5.4 \times 10^7$  respectively, with the maximum frictional drag rates being respectively 45 and 39 percent.

With the ejection rate and concentration held constant, drag showed a certain decrease as velocity increased, but the frictional drag reduction was greater than 33 percent throughout the experiment. The reason that the drag reduction was clearly greater for the flat plate than for the body of revolution was that the free surface caused a reduction in the average depth of the plate at high speeds. The wall concentration measurements are shown in Tables 4 and 5.

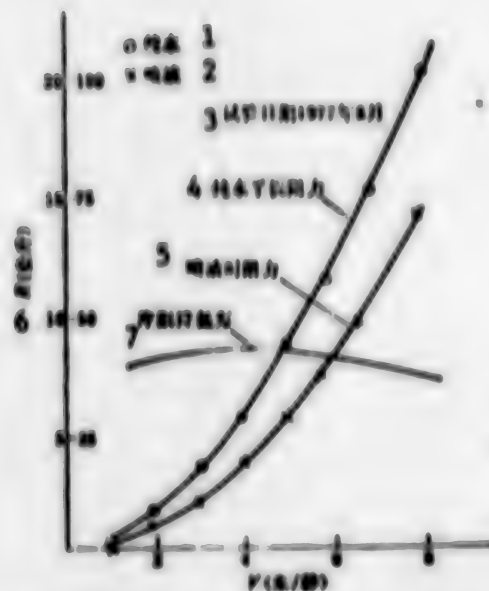


Figure 13. Drag reduction curves for flat plate with slot ejection

- Key:
- |                            |                                       |
|----------------------------|---------------------------------------|
| 1) Pure water              | 4) Drag for pure water                |
| 2) Fluid ejection          | 5) Drag with fluid ejection           |
| 3) August 1977 experiments | 6) R (kg)                             |
|                            | 7) Frictional drag reduction, percent |

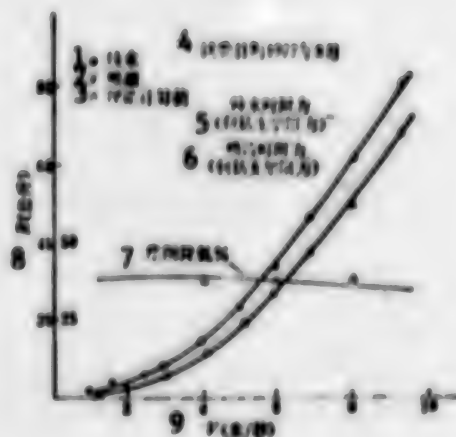
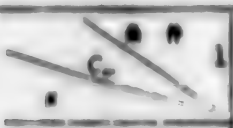


Figure 14. Drag reduction curves for body of revolution

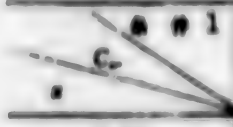
- Key:
- |  |  |
|--|--|
| 1) Pure water                                  | 6) Drag with fluid ejection (including support drag) |
| 2) Polymer ejection                            | 7) Frictional drag reduction, percent                |
| 3) Theoretically calculated value              | 8) R (kg)  |
| 4) August 1977 experiments                     | 9) V (m/sec)   |
| 5) Drag in pure water (including support drag) |  |

Table 4. Surface Concentration  $C_w$  for Flat Plate

	$V = 3.540$ $C_i = 530$ $Q_i = 1.0$	$V = 5.100$ $C_i = 530$ $Q_i = 1.0$	$V = 6.661$ $C_i = 530$ $Q_i = 1.0$	$V = 8.480$ $C_i = 1000$ $Q_i = 1.0$
0.235	420	478	440	563
0.375	310	364	360	532
0.681	200	272	204	503
1.170	37.3	63.4	60.0	68.0
2.202	31.5	13.7	14.3	16.1
2.767	8.6	8.4	8.8	14.3

Key: 1) Condition

Table 5. Surface Concentration  $C_w$  for Body of Rotation

	$V = 4.000$ $C_i = 530$ $Q_i = 0.74$	$V = 5.989$ $C_i = 530$ $Q_i = 0.74$	$V = 6.661$ $C_i = 530$ $Q_i = 0.89$	$V = 8.430$ $C_i = 1000$ $Q_i = 0.74$
0.455	104	100	113	430
0.930	116	112	100	288
1.441	114	104	110	196
2.143	12.8	5.9	7.7	17.8
3.042	8.1	3.5	6.7	13.8
3.842	6.1	3.4	6.3	11.0
5.744	6.3	6.4	6.2	10.0

Key: 1) Condition

In Tables 4 and 5, column  $x$  gives the distance from the front along the axis in meters;  $C_w$  and  $C_i$  are the concentration at the wall and initial concentration in ppm;  $V$  is the velocity in m/sec; and  $Q_i$  is the ejection rate in kg/sec.

The measurements show that near the ejection orifice the concentration along the wall shows large changes; at a distance of about 1.5 m from the slot, it is rather large, greater than the saturation value (25 ppm) for the drag reduction on a flat plate by a uniform fluid. In this area, the longitudinal concentration gradient is rather large and the concentration itself is dropping rapidly. Fitting the longitudinal wall concentration distribution to the two zones described in reference 13 is a bit forced.

As for the 3.463 m body of rotation, at the rear of the body there is a relatively long area where the wall concentration is changing rather slowly. The longitudinal concentration distribution along the walls not only shows a relationship to the figures given in reference 13, but should also be related to the ejection angle, the curvature of the body surface and the pressure field.



## 6. The Effect of a Surface of Uniform Roughness on Drag Reduction

In order to study the effect of roughness on drag reduction, experiments were made with a rotating disk and a slotted flat plate on a tank with a uniform solution. Sand with a grain size of 120 mesh was uniformly cemented to the surfaces of the disk and the plate, and drag reduction fluid PEO II was used. The experimental results are shown in Figures 15 and 16.

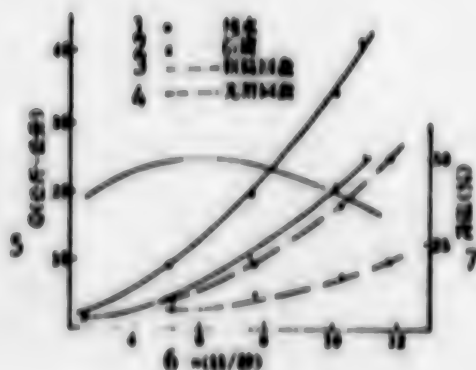


Figure 15. Rotational drag for smooth and rough disks in uniform solution

Key: 1) Pure water  
2) Solution  
3) Rough disk  
4) Smooth disk  
5)  $Q$  (kg-cm)  
6)  $n$  (rps)

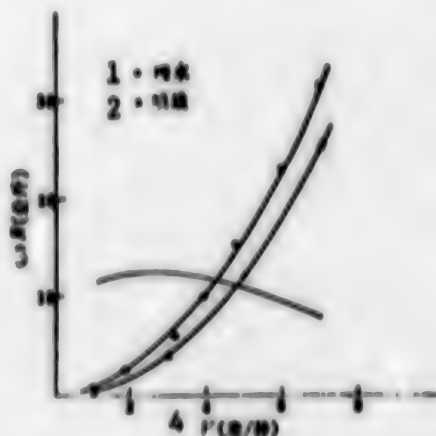


Figure 16. Drag reduction with fluid ejection, rough plate

Key: 1) Pure water  
2) Fluid ejection  
3)  $R$  (kg)  
4)  $V$  (m/sec)

The results show that the percentage drag reduction decreases with increased rotational speed and velocity, but for identical rotational speeds and velocities the absolute drag reduction is greater than for the corresponding smooth circular disk and plate, amounting to almost 1.3 times the drag reduction for the smooth surfaces. Because the roughness of the sand particles was relatively large, it may be that the drop was in eddy drag.

## 7. Calculation of Slot Ejection Drag Reduction for a Linear Body of Rotation

### A. Differential Equation for Shear in a Body of Rotation in Bypass Flow with Slot Ejection

The differential equation of motion of a body of rotation with bypass flow is

$$u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial y} = -\frac{1}{\rho} \frac{dp}{dx} + \frac{1}{\rho r} \frac{\partial(r\tau)}{\partial y} \quad (1)$$

where  $x$  is the coordinate tangential to the contour of the body's meridional plane,

$y$  is the coordinate normal to the contour of the body's meridional plane,

$u$  is the velocity component in the  $x$  direction,

$v$  is the velocity component in the  $y$  direction,

$p$  is the pressure,

$\tau$  is the shear stress,

$\rho$  is the mass density,

$r = r_0 + y \cos \varphi$ , where  $\varphi$  is the angle between the  $x$  direction and the axial line, and  $r_0$  is the distance between a point on the surface of revolution and the axis. The continuous equation is

$$\frac{\partial(ru)}{\partial x} + \frac{\partial(rv)}{\partial y} = 0 \quad (2)$$

Using F.M. White's<sup>14</sup> and W.A. Meyer's<sup>15</sup> combined model of the velocity profile in the boundary layer, the equation is

$$u^* = \frac{u}{v_*} = A \ln y^* + B + b a y^* + \Delta B \quad (3)$$

when  $v_* = \sqrt{\frac{\tau_w}{\rho}}$ ,  $y^* = \frac{v_* y}{\nu}$ ,  $a = -\frac{v}{\tau_w v_*} \frac{dp}{dx}$

$$b = \begin{cases} 0.6 & \text{正压力梯度} \\ 0 & \text{零或负压力梯度} \end{cases}$$

$$\Delta B = 1.1 \ln \frac{v_*}{v_{*cr}} \quad (4)$$

Here  $v_{*cr}$  is the initial shear velocity producing drag reduction.

The function  $\Gamma = \Gamma(C)$  depends on the concentration  $C$ .

When  $y \rightarrow \delta$ , i.e.  $y^* \rightarrow \delta^*$ , we obtain

$$u^* \Big|_{y^*=\delta^*} = \frac{U}{v_*} = a = A \ln \delta^* + b a \delta^* + B + \Delta B \quad (5)$$

Equation (5) is an implicit partial shear equation in which  $\sigma$  is the quantity to be found; it can be expressed as

$$\frac{1}{\sigma^2} = \frac{r_0}{\rho U^2}.$$

In Equation (5),  $\delta^+ + \frac{v^*}{U}$ , where  $\delta$  is the thickness of the boundary layer and  $U$  is the velocity at the outer edge of the boundary layer.

For a thin boundary layer,  $\delta/r_0 \ll 1$ , and we can derive from the above formulas a differential expression for the wall shear stress for bodies of revolution:

$$\begin{aligned} (G - 3b\bar{u}H)\sigma' + \frac{\bar{V}'}{\bar{V}} \cdot \sigma(\sigma^2\delta' - G) - \sigma^2\left(\frac{1}{\bar{V}}\right)' \frac{bH}{Re} \\ + \frac{\bar{V}'}{\bar{V}} \sigma\delta' \left[ \left(A + \frac{bab'}{2}\right) - \frac{1}{3} b^2\sigma^2\delta'^2 - \frac{3}{2} A bab' \right] \\ - \sigma\delta'(\sigma - 2A - bab')(\Delta B) = Re\bar{V} \end{aligned} \quad (6)$$

where

$$\begin{aligned} H &= -\frac{\sigma b^2\delta'^2}{2} + 2 \int_0^{\delta'} u^* y^* dy^* = \frac{\delta'^2}{2} \left( \sigma - A - \frac{2}{3} bab' \right), \\ G &= \int_0^{\delta'} u^{*2} dy^* = \delta' \left[ (\sigma - A)^2 + bab' \left( \sigma - \frac{2}{3} A - \frac{1}{3} bab' \right) \right], \\ \bar{V} &= \frac{U_0}{U_\infty}, \quad \text{when } U_0 \text{ is the flow velocity for unperturbed flow;} \\ Re &= \frac{U_\infty l}{\nu}, \quad \text{when } l \text{ is the length of the model and } \bar{r} = \frac{r_0}{l} \end{aligned}$$

Here the single and double primes indicate the first and second derivatives of  $\bar{x} = \frac{x}{l}$ .

$$(\Delta B)' = -\frac{\Gamma'}{\Gamma} \Delta B + \Gamma \left( \frac{\bar{V}'}{\bar{V}} - \frac{\sigma'}{\sigma} \right) \quad (7)$$

The only difference from the usual method of handling boundary layer equations is the addition of equation (3) which reflects the belief that in the flow of a dilute polymer the viscous lower layer thickness increases, so that the velocity profile shows an upward shift in the logarithmic relationship by an amount  $\Delta B$ .

### 3. Discussion of the Differential Stress Equation

(1). When  $\Delta B = 0$  in equation (6), we have the differential stress relationship for a body of rotation in pure water.

(2). From equation (7), when a uniform fluid flows around a flat plate we have

$$(\Delta B)' = -\Gamma \frac{\sigma'}{\sigma},$$

so that equation (6) becomes

$$\delta^*[(\sigma - A)^2 + A^2 + \Gamma(\sigma - 2A)]\sigma' = Re$$

or

$$\delta^*[(\sigma - A)^2 + A^2 + \Gamma(\sigma - 2A)] \frac{d\sigma}{dR_*} = 1 \quad (8)$$

Here,  $R_* = \frac{U \omega x}{\nu}$ . When  $\Gamma/A$  is an integer in equation (8), we have the following analytical expression:

$$Re = \nu^{2/3} \delta^* (a_n)^{1/3} [a_{(n/A+1)} + (1-2A)a_{(n/A+1)} - 2A(1-A)a_{(n/A)}] \quad (9)$$

where

$$a_n = \delta^* e^{n/3}, \quad a_{n/A} = \{ \nu^{1/3} e^{n/3} - \Gamma/A a_{(n/A+1)} \}, \quad a_n = U/\nu_{cr}^*$$

When  $\Gamma/A = 0$ , we have the solution for pure water flowing around a flat plate. The frictional drag coefficient for flow around the plate is

$$C_f = \frac{2}{Re} \int_0^{R_*} \frac{dR_*}{\sigma^2} = \frac{2}{Re} \left[ \frac{1}{\sigma} \int_0^{\delta^*} u^*(\sigma - u^*) dy^* \right]^{(10)}$$

For the present velocity profile model, the frictional drag coefficient is

$$C_f = -\frac{2A\delta^*}{Re} \frac{(\sigma - 2A)}{\sigma} \quad (10)$$

For pure water with  $\Gamma/A = 0$  and  $U\omega = 10$  m/sec, the value of  $\nu_{cr}^*$  for polyethylene oxide is 0.023 m/sec; the curves for  $C_f$  and the Reynolds number when the concentration  $\Gamma/A = 1, 2$  and 5 are shown in Figure 17.



Figure 17. Drag coefficient for flat plate with uniform PEO solution

(3). The bypass flow separation condition for pure water is  $G-3baH = 0$ . In the presence of a drag reduction polymer, the conditions for the separation point are:  $G-3baH + \Gamma\delta^+ (\sigma - 2A-2ba\delta^+) = 0$ , where the additional third term is generally greater than zero, and if there is separation, the separation point is shifted (in reality,  $G$  and  $H$  both change).

(4). In order to solve equation (6), it is very important to set up an equation for the longitudinal distribution of concentration along the wall. If we assume that the ejected polymer has a diffusion rate in the boundary layer which is similar to the diffusion law for a line source in a turbulent boundary layer, the concentration along the wall in the last section is  $C_w(x) = g/0.55\delta U$ , where  $g$  is the ejection quantity per unit length; if we take  $\Gamma$  as directly proportional to  $C_w$ , we have

$$\Gamma\sigma\delta = \text{constant} [1603 \ 6852] \quad (11)$$

Combining equations (4), (5) and (11), we obtain the nonuniform density  $(\Delta B)'$

$$\begin{aligned} (\Delta B)' = & (K_1(\sigma + \Gamma + \Delta B - 3bab') - (\Gamma + \Delta B)) \frac{\sigma'}{\sigma} \\ & + \left[ \Gamma - K_1(\Gamma - 2bab') \frac{\bar{v}'}{\bar{v}} \right] - K_1bab' \frac{\bar{v}''}{\bar{v}'} \end{aligned} \quad (12)$$

$$\text{where } K_1 = \frac{\Delta B}{\Delta B - A - ba\delta^+}.$$

### C. Comparison of Theoretical Calculations and Experimental Results

For a body of rotation 5.62 m long, we made theoretical calculations of drag reduction at speeds of 4, 6 and 8 m/sec, using A.D. Young's and P.R. Owen's<sup>18</sup> calculation for potential flow. Equation (6) was solved by the Runge-Kutta method. We took  $C_w = g/0.55\delta U$ , and calculation was made from equation (12) for  $(\Delta B)'$ , producing drag reduction results which were always somewhat lower than the real values. The equations for  $C_w$  cannot reflect the real, very high concentration of the fluid at a slight distance from the slot. In this article we took an average of the experimentally determined wall concentrations as the basis for calculations. We determined the initial value of  $\sigma$  from equation (5), and the boundary layer thickness  $\delta$  was as in reference 19:

$$\left( \delta = \frac{0.0598S}{\log R_s - 3.17} \right),$$

where  $S$  is the curvilinear length from the front of the object and  $R_s$  is the corresponding Reynolds number. For the calculations we took  $\Delta B = C_w \log v^*/v_{cr}^*$ . Figure 18 shows the curve for the shear stress coefficient

$$\tau_w/\rho U^2 = \frac{1}{\sigma^2} \quad \text{for pure water and a slot-ejected polymer at 500 ppm with}$$

a flow speed of 4 m/sec; the other values were similar.



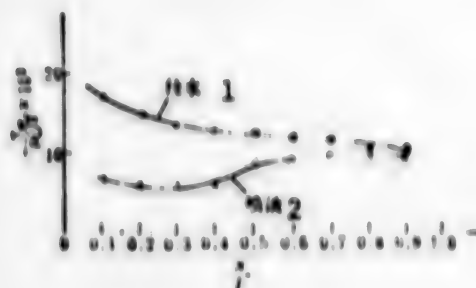


Figure 18. Calculated values of  $c_w / \rho U^2$  for pure water and fluid ejection

Key: 1) Pure water

2) Fluid ejection

Certain characteristics of the curve from the theoretical calculation of  $c_w / \rho U^2$  can be explained in terms of the corresponding terms in equation (6). For pure water, when  $\bar{V}'/\bar{V}$  and  $\bar{r}'/\bar{r}$  at the tail of the object are rather large negative values this results in a rapid increase in  $\sigma'$ , so that  $c_w / \rho U^2$  falls rapidly at the tail. Since the shear strength difference and shear stress are related to the surface integral of the body, we can separately determine the friction drag coefficient and the drag reduction value; the theoretically calculated friction drop can be compared with Figure 14, showing that the theoretical results are in agreement with the experimental results. This method can be used in calculating drag reduction by fluid ejection for bodies of rotation. But strictly speaking if we used the Meyer model for external flow, and especially for external flow with nonuniform density, we would need direct measurements for proof. The physical significance of all terms in equation (6) is apparent, calculation is simple, and they provide a method of calculating drag reduction which is fundamentally in agreement with experimental results.

### 8. Conclusions

A. When polymer ejection is used to reduce drag, for a streamlined body 5 meters long or slightly longer, it is only necessary to provide a slot or a row of holes to produce a friction reduction of 30-40 percent.

B. When fluid ejection is used for self-propulsion tests with a body of revolution equipped with a propeller, there is only a very small change in the thrust reduction factor, while the wake fraction decreases. The noise of the stern propeller decreases somewhat.

C. Formula (6) in this article can be used in theoretical calculations for slot ejection drag reduction, and the calculated results are fundamentally in agreement with experiment.

The noise measurements in this article were provided by Comrades Chen Yunfen [7115 7301 5358] and Qian Dexing [6929 1795 5281]; help during the experiments was provided by Li Xiangpu [2621 4382 2528], Dai Tao [2071 3447], Shi Mingbao [0670 2494 0202], Xie Gangshu [6200 4854 2885], Han Qi [7281 3825] and Zou Dexiang [6760 1795 4382]. Here we express thanks to them all.

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## APPLIED SCIENCES

### BRIEFS

**ZHEJIANG LASER REFLECTOR**—The Optical Membrane Research Laboratory under the Optical Instruments Institute of Zhejiang University has succeeded in developing a laser reflector with reinforced membrane [yong mo 4289 5229]. Evaluation by some 30 fraternal units shows that the new device is up to advanced level. [Hangzhou Zhejiang Provincial Service in Mandarin 0400 GMT 12 May 80 OW]

**SHANDONG MATHEMATICS SEMINAR**—Entrusted by the China Mathematics Society, the Mathematics Research Institute of the Chinese Academy of Sciences and Sichuan and the Shandong Universities recently held a national seminar on number theory in Jinan Municipality, Shandong Province. Hua Luogeng, a famous mathematician and vice president of the Chinese Academy of Sciences, presided over and addressed the seminar. Zhao Lin and Gao Qiyun, secretaries of the Shandong Provincial CCP Committee, extended their greetings to the participants at the seminar. [Jinan Shandong Provincial Service in Mandarin 2300 GMT 29 Apr 80 SK]

**MATHEMATICS SYMPOSIUM**—Jinan, 4 May—The second national symposium on the theory of numbers was held in Jinan, Shandong, recently. The symposium was sponsored by the China Mathematics Society and attended by society council Chairman Hua Luogeng and some 30 well-known mathematicians in the country. The participants exchanged academic views and heard 21 papers. They called for building a contingent of scientists and technicians and paying attention to promoting young mathematicians so as to raise study of the theory of numbers in China to the world level. [OW081233 Beijing XINHUA Domestic Service in Chinese 0746 GMT 4 May 80 OW]

**FIRST DILUTION REFRIGERATOR**—Beijing, 18 May—The Physics Institute under the Chinese Academy of Sciences has successfully developed a dilution refrigerator, the first ever made in China. According to experts' appraisal, the refrigerator's technical quality is just as good as that of the same product made abroad. As an important tool for conducting low-temperature research, the refrigerator will broaden research in our country. [Beijing XINHUA Domestic Service in Chinese 0114 GMT 18 May 80 OW]

**SOUTH CHINA SEA GEOLOGY PERSONNEL**--Recently, the South China Sea Geology Survey Command has adopted measures for giving play to the activism of the science and technology personnel. In accordance with the characteristics of ocean geology work, the command party committee has generally established full-time teams for comprehensive research, ocean survey and ship repairs. These teams have also established provisional party committees to strengthen their leadership, and selected 10 young and experienced party members and cadres for the leadership posts in the party committees. Technicians account for 44 percent of the total number of persons in the leadership posts. [Guangzhou Guangdong Provincial Service in Mandarin 2330 GMT 21 Apr 80 HK]

**ZHEJIANG INFRARED TECHNOLOGY EXHIBIT**--The Zhejiang provincial infrared technological information and application exhibit opened in Hangzhou, Zhejiang, on 6 May. The exhibit introduced Zhejiang's experience in disseminating this new technology over the past few years. The infrared heating and drying technique is now applied in light, textile, chemical and other industries. Thanks to the extensive application of infrared technology, Zhejiang has saved 32 million kwh of power output each year in the past 2 years. After the exhibit closes in Hangzhou, it will be held in Jiaxing, Jinhua, Wenzhou and Ningbo on a rotational basis. [Hangzhou Zhejiang Provincial Service in Mandarin 1100 GMT 11 May 80 OW]

**SHANGHAI POLYCRYSTALLINE SILICON STICKS**--The Shanghai No 2 smeltery recently successfully developed production of major-diameter-155mm--polycrystalline silicon sticks, thus creating a very important condition for producing major-diameter monocrystalline silicon. China had produced polycrystalline silicon sticks of diameters below 100 mm only. [Shanghai City Service in Mandarin 1130 GMT 12 May 80 OW]

**HEAT TREATMENT MEETING**--The second national experience-exchanging meeting on heat treatment, sponsored by the State Economic Commission and the general office of national defense industry under the State Council, opened in Shanghai on 20 May. Attending the meeting are responsible persons of concerned departments of the State Council and representatives from 28 provinces, municipalities and autonomous regions, more than 700 people in all. The first such meeting was held in 1977. [Shanghai City Service in Mandarin 2300 GMT 20 May 80 OW]

CSO: 4008



## LIFE SCIENCES

### SCIENTISTS DEVELOP NEW DEVICE FOR QIGONG THERAPY

OWO80932 Beijing XINHUA in English 0746 GMT 8 May 80

[Text] Beijing, May 8 (XINHUA)—A hospital of traditional Chinese medicine and electronics experts have developed a number of devices that can record emissions from people who practice the ancient art of qigong.

The emissions, which are said to have healing qualities, are recorded on cassette tapes and played back to patients in the form of infra-red signals.

At Qingdao Hospital, Shandong, where one of the devices was developed, 159 patients with high blood pressure were given treatment with the qigong machine. The hospital reports that 113 of them benefited from the treatment.

Similar machines have been developed by Beijing's semi-conductor institute, under the Chinese Academy of Sciences, and other scientific institutions.

Qigong, a discipline of concentration, breath control and exercises, has a history of about 3,000 years. In traditional Chinese medicine it is regarded as a health science. Since 1978, when interest in qigong was revived, several science magazines have carried articles which state it has been scientifically proved that a qigong therapist can emit certain waves from his palm or finger when he concentrates on it.

The impulses have been identified as infra-red rays, static electricity, and changes of magnetic field.

A medical scientist told XINHUA that the impulses can be captured on a tape. Later, when they are played back as infra-red rays and focussed on a sick person, they are thought to stimulate the patient's own recuperative powers.

The beam is usually concentrated on an acupuncture point. Acupuncture is the practice of inserting steel needles in the skin at points along channels that are thought to connect internal organs with remote parts of the body.

According to Liu Jianhua, the president of the newly-established qigong society of Beijing, patients suffering from neurasthenia, bronchitis and coronary diseases have all benefited from treatment with the qigong machine.

He said: "The advantage of the qigong machine over other means of infra-red treatment is that the impulses emitted by the qigong therapist are weaker, and the instrument is applied to a specific point rather than irradiating a whole area of the body. Therefore, it is more suitable for delicate patients."

He said the society would continue to study the potential and application of qigong. Members include physicians, chemists, medical scientists and electrical technicians.

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## LIFE SCIENCES

### MICROBOMBS USED TO DESTROY BLADDER STONES

Shanghai WEN HUI BAO in Chinese 20 Apr 80 p 1

[Article by Ji Qing [4764 7230]: "Microbombs Destroy Bladder Stones; Sian City's Central Hospital Creates a New Path in Safe, Effective and Painless Treatment of Stones"]

[Text] Special Report from Sian—On April 8, a urological surgeon of the Central Hospital in Sian City placed a microbomb inside the bladder of patient Jia Guimin [6328 2710 3046]. After a "pa" sound, the patient felt a slight shivering in his abdomen. Examination by x-ray and a bladder examination instrument shows that a stone  $1.1 \times 0.8 \text{ cm}^2$  in size was blasted into four small stones and some smaller pieces. These were excreted in the urine one after the other. The bladder wall was not damaged in any way and the disease was totally cured. This means of treatment that has been applied clinically has created a new path in the medical use of explosives and the safe, effective and painless treatment of stones.

This experiment was proposed by engineer Zhang Jianzhong [1728 1696 0022]. Last October, he was inspired by reports from abroad and proposed the research subject of the application of explosives in medicine. He thought of using "microbombs" to blast stones inside the body to remove the stones without surgery. He and Xu Mincheng [1726 6900 4453], the principal physician of the department of urological surgery of the Central Hospital in Sian City discussed jointly and studied the questions concerning the amount and composition of the explosives, the way to place the explosive inside the body, what kind of equipment is needed, whether toxic reactions will occur after the explosion is set off inside the body, whether the explosion will damage normal tissues. They cooperated closely and after repeated studies and repeated practice, Zhang Jianzhong developed a prescription of a "bomb" suitable for exploding inside the body. Xu Mincheng coordinated with instructor Chen Wenying [7115 2429 5391] of the Sian Industrial Academy and its subsidiary factory's comrade workers and developed the equipment required to explode the explosive for treatment. Based on this, they conducted over 100 extracorporeal experiments, and conducted 13 directional experiments inside animal bodies. Massive data were obtained. The composition and amount of explosives were adjusted and the many difficult problems concerning insulation of the explosive and disinfection of the human body were solved. After full preparation, it was finally successfully applied in the human body.

## LIFE SCIENCES

### TREATMENT DEVELOPED FOR FINGER INJURIES WITHOUT LEAVING SCAR

Shanghai JIEFANG RIBAO in Chinese 21 Apr 80 p 1

[Article by Xu Jufen [6079 5468 5358]: "Doctor Mao Wenxian Successfully Develops Chinese Medicine 'Zhangpigao' To Treat Injuries on Finger Tips Without Leaving Scars"]

[Text] It is said "Wounds leave scars, cuts leave scars." But orthopedist Mao Wenxian [3029 2429 6343] of the People's Hospital No 9 in Shanghai used Chinese medicine "Zhangpigao" to treat damage to the finger tips without leaving a scar. In the office of the Orthopaedics Department we saw several sets of pictures of damaged finger tips before and after treatment, and it was indeed so.

Damage to the finger tip is a frequent and often seen external injury to the finger. Because the soft tissue on the finger is tight, damage to the skin cannot be easily sutured by relaxing the skin like other parts of the body. Therefore, whether it is an injury caused by a cut, a torn tissue, a crushing injury or broken finger, clinically such injuries are mostly treated by transplanting skin and suturing or setting broken bones. These leave scars and affect appearance and function. In addition, contraction and deformation and coalescence easily occur. The fingers hurt when touching objects, or the skin at the finger tips lose the sense of touch and feeling of temperature. These are not accepted by the patients.

In September of 1978, the emergency room of the orthopedics department admitted a young woman whose left middle finger's terminal phalanx was injured by a punching machine. Diagnosis showed the fingernail of the terminal phalanx of the finger was also removed in the injury. The doctor suggested that a dissociation skin transplant be performed. The patient refused and asked the doctor to think of other ways. Doctor Mao thought of Chinese medicine's many effective ointments used by Chinese medical practitioners and surgeons to treat wounds. He boldly selected one to treat her. Doctor Mao carefully applied the ointment and made observations. After 4 weeks the patient's injured fingertip grew back together and the result was exceptionally good. The length of the finger and function were the same as the original finger and the skin was smooth. The nail was bright and it could be said that the injury left "no scars."

Doctor Mao who has been practicing western orthopedics for 30 years actively discovered the use of Chinese medicine to treat injuries of finger tips. He referred to Chinese medical documents and developed a "zhanpigao" ointment which could help in the growth of both the subcutaneous tissue and skin especially for treating injuries of finger tips. For the past decade and more, Doctor Mao's patients have ranged in age from the youngest of 5 years old to the oldest of 73. The smallest injured area was 1 x 1 centimeter<sup>2</sup> and the largest injury was 3 x 2 centimeters<sup>2</sup> (including the entire terminal phalanx of the finger). Whether the terminal phalanx was horizontally cut and broken, or partially sliced away in front, in back or on the sides, there are no after effects after treatment. Doctor Mao Wenxian reported on "the use of Chinese medicine 'zhangpigao' to treat 50 cases of injuries of the finger tips and its effectiveness" at the 1979 annual orthopedics conference of the Chinese Medical Society and the reporting conference on traumatology of the Chinese association of traditional medicine. His report was welcomed and praised by participants.

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## LIFE SCIENCES

### HEALTH MINISTER CALLS FOR SUMMER SANITATION CAMPAIGN

OW301148 Beijing Domestic Service in Mandarin 1145 GMT 29 Apr 80

[Talk by Qian Xizhong, minister of public health and vice chairman of the Central Patriotic Sanitation Campaign Committee, entitled "Mobilize and Launch the Summer Patriotic Sanitation Campaign"--recorded; date and place not given]

[Summary] "The patriotic sanitation campaign is an important measure to safeguard the people's health and to insure the success of socialist modernization."

The campaign was sabotaged by Lin Biao and the "gang of four." However, since the downfall of the "gang of four," the Central Campaign Committee has been reorganized, leadership over the campaign strengthened, and a new high tide of the campaign whipped up.

To fundamentally solve various problems concerning sanitation in both urban and rural areas, the Central Patriotic Sanitation Campaign Committee called a meeting attended by all its members, directors of officers of the campaign in various localities of the country and responsible personnel from other departments concerned. The meeting summed up past experience and proposed future tasks for the campaign.

"The meeting called on party committees and governments at all levels to do their utmost to strengthen leadership over the campaign and to eliminate pests and diseases by adhering to the principle of 'treating a disease by looking into its root cause and symptoms, emphasizing the former.'"

The masses must be mobilized to promptly and conscientiously promote environmental sanitation as well as environmental protection so as to support the four modernizations.

As the early summer is the proper time to start activities to prevent and control pests and diseases, all localities and departments must pay attention to the following points in mobilizing the masses to launch the patriotic sanitation campaign:

1. In urban areas the sanitation campaign must be carried out to improve the urban outlook and social order. Environmental sanitation should be promoted by improving sanitation equipment; measures should be taken to eliminate pollution, both air and water; the environmental protection law must be strictly observed.

2. In rural areas the sanitation campaign must be closely combined with agricultural production. Water and nightsoil must be properly managed and environmental sanitation must be improved. Efforts must be made to wipe out four pests--rats, bedbugs, flies and mosquitoes--as well as to prevent and control outbreaks of epidemics during the summer.

3. Catering trade and food processing plants must strictly observe the state's regulations on food sanitation so as to safeguard the people's health. Commercial, public security and public health departments must coordinate and conduct food inspections to prevent food poisoning.

4. The importance of hygiene must be energetically publicized and knowledge on sanitation popularized among the masses. Secondary and primary school students must be actively organized to take part in the sanitation campaign so as to improve their hygiene knowledge and sense of social ethics.

5. Efforts must be made to carry out afforestation work well since it is conducive to regulating the climate, purifying the air and protecting the environment.

Members of the Beijing Municipal Patriotic Sanitation Campaign Committee and leading members of the Public Health Ministry are now conducting an inspection of Beijing's environmental sanitation so as to improve the sanitary outlook and make it a good example in environmental sanitation for other localities to follow.

"Under the impetus of the guidelines of the 5th plenary session of the 11th party Central Committee, all localities, departments and units must start with their own actual conditions, work out reliable and feasible plans, promptly whip up a new high tide of the summer patriotic sanitation campaign, further improve the sanitary outlook of both urban and rural areas in our country, promote the development of agricultural and industrial production and reduce the number of diseases so as to better serve the four modernizations."

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## LIFE SCIENCES

### BRIEFS

**GYNCOLOGY, OBSTETRICS MEETING**--According to Shanghai's WEN HUI BAO, the second national gynecology and obstetrics academic meeting of the Chinese Medical Society was held in Suzhou, Jiangsu, 3-9 May. The meeting discussed the question of putting China's population growth under control and further promoting birth planning and women's health. Li Xiuzhen, member of the Public Health Ministry party group and deputy head of the birth planning leading group of the State Council, attended the meeting and spoke at the closing ceremony. [OW131325 Shanghai City Service in Mandarin 2300 GMT 11 May 80 OW]

**NEI MONGGOL PUBLIC HEALTH**--In early April, the Patriotic Public Health Committee of the Nei Monggol Regional Military District issued a circular to PLA units, departments, hospitals and warehouses of the military district urging them to launch a spring patriotic public health campaign. In response to this circular, the headquarters, the political department and the logistics department of the regional military district acted immediately and a vigorous public health campaign was developed, bringing about an entirely new look to the environmental conditions of the barracks areas. [Hohhot Nei Monggol Regional Service in Mandarin 1100 GMT 23 Apr 80 SK]

**FUJIAN PUBLIC HEALTH CONFERENCE**--The Fujian Provincial People's Government recently held a work conference on public health in Fuzhou to study and discuss the main tasks this year. The conference demanded that the province work hard to grasp public health in the rural areas. It is necessary to enable over 80 percent of the production teams to implement the cooperative medical system and improve the standards of the "barefoot" doctors. The conference held: It is necessary to strengthen disease prevention to protect the people's health and meet the demands of the four modernizations. We must further rectify the medical organizations in the municipalities and the rural areas and improve the quality of work. Zhang Gexin, vice provincial governor and director of the propaganda department of the Fujian Provincial CCP Committee, attended the meeting and spoke. He demanded: Public health departments must continue implementing the eight-character principle and grasp well disease prevention work. It is necessary to promote the patriotic and public health movement before May Day. [Fuzhou Fujian Provincial Service in Mandarin 1035 GMT 23 Apr 80 HK]

**COMPUTERIZED MEDICAL DIAGNOSIS**—Nanchang, 11 May--China is now using computers to diagnose heart and blood vessel diseases, including those which cannot be diagnosed by electrocardiogram. Diagnosis by computers is the initial fruitful result achieved from studying patients' pulse conditions by integrating the latest scientific techniques with the traditional Chinese medical practice of making a diagnosis by feeling the pulse. Thanks to the coordinated efforts made by Zhang Daxiang, chief physician of the Nanchang Municipal No 2 Hospital, Jiangxi, and Xiao Xingguan, surgeon of the Military Medical School of the Fuzhou PLA units, a pulse conditions research coordination network has been set up in over 30 units in 7 provinces and municipalities. After more than 50 calculations and statistical analyses by means of computers, it has been proven that pulse conditions can be used to measure pathological and physiological changes in the human body. Diagnosis by means of pulse condition charts has also shown to be highly accurate. [OW131325 Beijing XINHUA Domestic Service in Chinese 0147 GMT 11 May 80 OW]

**NATIONAL HEART DISEASE CONFERENCE**—Shijiazhuang, 17 Apr--China recently held a national conference on general survey of hypertension and planning of scientific research on heart and vascular diseases. The conference was held in Shijiazhuang, Hebei, and attended by experts, professors and scientific researchers. Participants called on the government and people to pay more attention to prevention and treatment of heart and vascular diseases. Chinese people suffer more strokes but fewer coronary diseases and myocardial infarctions than the peoples of Europe and the United States, according to a report at the conference. [Beijing XINHUA Domestic Service in Chinese 1318 GMT 17 Apr 80 OW]

**BONE GRAFT SURGERY**—Jinan, Apr 7 (XINHUA)—A new method of bone grafting has been developed by Chinese surgeons to treat benign and malignant orthopedic tumours. The new method, introduced by the orthopedics department at a hospital attached to the Shandong Medical College, has been recommended by an appraisal committee consisting of 30 orthopedic specialists from various parts of the country as worthy of clinical application. This hospital used bone grafts taken from dead human bodies to replace the tumour-infected parts of a patient's joints. The hospital has undertaken 28 such operations since 1974. Twenty-five proved to be satisfactory. Of the other three, a relapse occurred in one case, there was an infection in another, and the hospital lost contact with the third patient. The bone to be grafted is taken from fresh corpses, regardless of sex and blood type, except that it is not taken from a patient with a malignant tumor or a person who died of a contagious disease. The bone should be kept in an alcohol solution and it is usable within 6 months. Such surgery is applicable to big benign tumours in the joints, relapses after curettage of bone tumors, bone tumors with early malignancy or an inclination to malignancy, and to other injuries to the bone. [Beijing XINHUA in English 1221 GMT 7 Apr 80 OW]



DICTIONARY OF TIBETAN MEDICINE--Lhasa, 9 Apr--A dictionary of Tibetan medicine, compiled by a 29-year-old Tibetan doctor, will be published soon in the Tibetan language by the Nationalities Publishing House in Beijing. The dictionary, which lists 10,000 terms, was compiled by Dr Wangdui who began his training when he was 17 under the guidance of veteran doctors. In compiling the dictionary, he drew on more than 120 classical works on Tibetan medicine and was also helped by old doctors. [Text] [Beijing XINHUA in English 0725 GMT 9 Apr 80]

SHANGHAI MEDICAL FILM MONTH--Shanghai, 13 May--Shanghai's medical film month that began April 10 and ended recently, presented 41 films free of charge throughout the city and suburbs. Films include "Babyhood Hygiene," "Family Planning," "Prevention of Myopia," "No More Hunchbacks," "Laser-cured Common Diseases," "Hygiene Knowledge of Youth," "Structure and Pulsation of the Heart," and "Smoking Harms Your Health." The activity was sponsored jointly by eight organisations in Shanghai, including the Shanghai Patriotic Health Movement Committee, the Shanghai Birth Planning Office, the Shanghai Film Bureau and the Shanghai Association of Scientists and Technicians. During the special film month, the Shanghai television station also increased shows of scientific films. [Text] [Beijing XINHUA in English 0717 GMT 13 May 80 OW]

CSO: 4008



## SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

### MORE RESEARCH SOCIETIES SPRINGING UP IN TIANJIN

Tianjin TIANJIN RIBAO in Chinese 17 Mar 80 p 1

[Article: "Various Learned Societies Organize Gridlike Network of Scientific Organizations"]

[Text] A new flower is springing up in our city's scientific institutions--a number of scientific and technological research societies have been established in rapid succession, developing a significant effect toward attacking the objectives of scientific research for developing the four modernizations. In just over a year 82 projects have been completed, some of them at the advanced level both internally and abroad. At the same time technical talent has been developed.

Besides restoring and building up learned societies, the city's scientific society has, in keeping with the requirements for buildup in the four modernizations, beginning in July 1978, established 16 research societies involving applied mathematics, petroleum conservation, solar energy technology, food industry technology, television technology, instrumentation and automation technology, low-pressure jet technology, Chinese message processing, automation technology, plasma technology, nomology, computer technology, chromatology and laser technology, residual heat utilization technology, and household electrical appliances; and organized an amateur scientific research unit of over 1,200 persons to conduct specialized academic research and cooperate in attacking the objectives. These research societies have been formed by senior institutional instructors with an interest in research in certain fields or projects; scientific and technical personnel of scientific research agencies, plants, and enterprises; and workers and cadre producing or utilizing new technical equipment. Being voluntary participants, their level of activism is very high, which facilitates development of their specialties. Among them are also many in scientific and interdisciplinary fields, so that by using the strengths of some to make up for the weaknesses of others and pooling brainpower for broadened benefit, much is gained in research on the frontiers of science and in new technologies. Research societies and learned societies form a gridlike network of scientific research organizations which exhibit a flourishing vitality.

These research societies have made significant achievements with respect to attacking scientific research objectives. The Nomography Research Society is currently our country's sole nomographic scientific research body. Its membership also includes "corresponding members in Shanghai, Xi'an, and Harbin. This research society has already developed and produced 26 types of useful nomographs and specialized slide rules, some of which are now in wide use, and some of which have filled national voids. The fluoroscope developed by this research society in conjunction with Tianjin's 11th Plastic Material Plant can be widely used in engineering and mechanical design and has reached the advanced level of similar products abroad. The solar energy heat accumulator prototype completed by the Solar Energy Research Society took third place when entered in last year's national competition. It is in wide use in 104 units in the city, and can save over 2,000 tons of coal a year for the nation. In cooperation with a number of plant enterprises in an attack on objectives, the research societies have also solved a number of key problems in production technology.

In addition to achieving results in development of the four modernizations, these research societies also develop talent. Through these research societies, many scientific and technical personnel have come into contact with and grasped knowledge outside their specialty fields. Through participation in the activities of a research society, scientific and technical personnel of the Electrical Appliance Research Institute studied and grasped computer software technique, and, in designing items to match the international level of the 1970's, fully utilized what they had learned, successfully accomplishing their mission. The various research societies regularly sponsor study courses to develop technical talent. Eight courses have been presented by the Instrumentation and Automation Research Society alone, training over 700 persons to serve as a technical backbone.

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CSO: 4008

## SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

### PROFILE SKETCH OF LEADING BIOCHEMIST WANG DEBAO

Shanghai JIEFANG RIBAO in Chinese 13 Apr 80 p 1

[Article by reporter Jia Paoliang [6328 1405 5328]: "History of Scientist Wang Debao"]

[Text] On 5 January 1980, two Shanghai newspapers carried the front-page news that "our country scored a breakthrough in synthesizing ribonucleic acid, another exciting development after the successful synthesis of crystallizing bovine insulin, the first of its kind in the whole world. This shows that our country has reached an advanced international level in this particular field...." This important news was carried by HSIINHUA the same day.

This high-level achievement represents the collective wisdom of our scientific workers as well as the endeavor of a senior scientist, Wang Debao [3769 1795 1405], a research fellow of the Shanghai Institute of Biochemistry of the Chinese Academy of Sciences, who organized and participated in this scientific research project.

I. A well-known biochemist both in China and abroad, Wang Debao has been a leader in our country's biochemical study of nucleic acid. He was educated in America, where he received his doctorate from Western Reserve University, Cleveland. He has contributed seven articles to the widely acclaimed series "The Method of Enzymology." Braving all kinds of difficulties and obstructions, Wang Debao left the United States in 1954 and returned to China via Europe. Cared for and backed by the party and government, he founded the first nucleic acid research laboratory in China--a field hitherto untouched by anyone else in our country.

Scientists, including Klick and Watson, cracked the secret of heredity in the 1950's and established the theory that nucleic acid is a medium in living bodies working for reproduction of the species and the preservation of identities between parents and offspring. This discovery of research is to establish the relationship between the structure and functions of nucleic acid, and the composition of these substances. Wang Debao has been working in this particular field since right after his return to China. He has written over 20 papers on the purification,

structure, metabolism, etc., of nucleic acid. His studies have drawn the attention of biochemists both in China and abroad. He agreed not long ago to write two articles for the "Biochemistry Handbook" published in England. It is a reference book for biochemists in all countries. The German Biochemistry Society has asked for permission to include his studies in its publications. The biochemists of other countries consider Wang Debao "a first-rate biochemist of China," and find "the studies of the Wang group in Shanghai most noteworthy."

Wang Debao and other scientific workers began in 1967 to launch a project to synthesize nucleic acid. But his golden age of scientific research was soon eclipsed by a nationwide political storm. Wang Debao in 1968 was branded a "reactionary authority in science and technology" and soon was locked up in the "cowshed" as a "suspect special agent." After his "liberation" from the "cowshed" he was sent to the cadre school to do hard labor before he was told to proceed to another study group. Then he was asked "to battle high temperatures" in factories, or to build air raid shelters.... His research project was shelved and a lot of valuable time was wasted. After the overthrow of the "gang of four," Wang Debao felt so relieved that he declared: "This is another golden age of my lifetime."

II. Ten years of disasters have left the scars of so much devastation that Wang Debao feels deeply concerned about the delay of this research project. Turning their attention to this project after the overthrow of the "gang of four," the Chinese Academy of Sciences and its Shanghai branch called a meeting of all concerned in 1977 to devise coordination measures, but no consensus developed. Some favored a switch to some new project, while others questioned the feasibility of the synthesizing approach. As leader of the project, Wang Debao, who knows all the details of the project, finally spoke very candidly: "Since there is political stability, we should not let this golden opportunity slip. With the foundation we have built, we will achieve a breakthrough shortly if we concentrate our manpower and work together wholeheartedly." The leadership of the academy accepted Wang's opinion and organized three task groups to deal with three vital processes of the synthesis of nucleic acid, namely, enzyme instrumentation, exploration of biological activities, and final synthesis of the parts. Wang Debao himself became the head of the final synthesis group. Since then he has spent numerous days and nights in the laboratory, foregoing all holidays and vacations. Despite being a victim of a chronic illness, Wang stayed with the group all the time. Moved by his dedication, some comrades who work with him exclaimed: "Old Wang dedicates himself body and soul to each step of the experiment."

The nucleic acid which our scientists set out to synthesize consists of 76 nucleosides with a molecular weight of about 25,000. Each nucleoside is like a boxcar in a train. One can imagine the difficulties involved in synthesizing all these fragments to form one biologically active



substance. After careful study with the scientific and technological workers, Wang Debao finally mapped out the method of synthesis: to separate whole nucleic acid into two fragments, one consisting of 41 nucleosides and other 35. The one with 41 nucleosides was to be separated into three fragments of 10, 12, and 19 nucleosides respectively, and they were to be synthesized separately. After a little over a year of round-the-clock effort on the part of all concerned, they finally overcame the problems of facilities and technology and succeeded in synthesizing the three fragments separately.

The project reached its crucial stage in December 1979 when the total synthesis of the three fragments was to take place—a vital step to the entire project. The process of total synthesis is a continuous experiment which allows no stops whatsoever. Thus, many comrades brought their bedding to the laboratory, and each worked a 12-hour shift. Wang Debao was there all the time to guide every link of the process. By midnight on 27 December the synthesis of the three fragments consisting of 41 nucleosides finally succeeded, to the delight of the entire laboratory. But Wang Debao did not want to announce the result lightly. He kept the experiment going for another 2 days to prove the dependability of the process. This important breakthrough has paved the way for our scientists to achieve complete synthesis of whole nucleic acid.

III. As head of the research laboratory, Wang Debao is very strict about what he himself and his associates should do in their research. Carefully supervising papers published in the name of the laboratory, he always reads and polishes them until he feels sure they are ready for publication. This helps his researchers improve the quality of their work and form a more serious attitude toward their research. For instance, he once retracted an article which a researcher had sent to the *BIOCHEMISTRY JOURNAL* for publication because it contained a doubtful point requiring further clarification. He worked with the researcher on the article until the point was cleared up.

A year ago, the Biochemistry Institute was authorized by the Academy of Sciences to reinstitute its higher biochemistry training program. Wang Debao wrote his own teaching materials and also encouraged his researchers to write on assigned topics. When a text of more than 100,000 words was ready, Wang took time to revise and proofread the final edition. He lectures at the training class. To provide an opportunity for his researchers to train themselves, he asks them to lecture as much as possible. Researchers working under Wang Debao show remarkable progress. Some of them have become associate or assistant research fellows. They are the core of a force engaged in our country's nucleic acid research project.

Wang Debao does not put on airs of a celebrity. He is accessible to all those who seek his advice, no matter whether they are somebody or nobody. In May a year ago, he was appointed head of the nucleic acid delegation



to tour abroad. Before he left China, Wang Debao made a last-minute effort to answer a letter written by a biochemistry student of the Department of Biology at Sichuan University, who asked Wang to comment on a controversial problem he had run into in his studies. Mail of this kind always floods into Wang Debao's office. Some of it is from college professors interested in getting new data from Wang. Some mail contains articles written by scholars in distant provinces and submitted to Wang for comments. Other letters are requests to visit Wang. He is always happy to help. When he taught biochemistry at both Fudan University and the University of Science and Technology, his friends remarked humorously: "Old Wang's basket is overlaid with students."

At a lively tea party in the beginning of 1980 for scientists in Shanghai, Wang Debao said, among other things: "The road to success in science is pretty rough. Most people who set out to go 100 miles often find it wise to stop at 90. I am over 60 years old, but I want to spend the rest of my life on science to help our biochemical science surpass the world's most advanced level as soon as possible."

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CSO: 4008

AUTHOR: ZHOU LI [0719 4539]  
SONG Zulián [1945 4371 6991]

ORG: None

TITLE: "Rare Metals, Niobium and Tantalum"

SOURCE: Beijing XIANDAIHUA [MODERNIZATION] Vol 2, No 4, 16 Apr 80 pp 19-20, 16

ABSTRACT: Niobium and tantalum are twin elements of like characteristics, which are primarily high heat resistance. When niobium is added to carbon steel, at a rate of several parts to ten thousand, the strength of the steel may be improved more than one third. They, especially tantalum, are very corrosion resistant. At present, more than half of tantalum production in the world is used to make large capacity, small volume, and highly stable solid electrolytic capacitors, which have many advantages over those made with other materials. The two metals are also superior superconductors. Under extremely low temperature, their resistance equals to zero to cause them to be better superconductors than copper and silver. In surgery, tantalum may also be used as replacement for bones or muscles. The paper written by the first author and illustrated by the second describes, in general terms, the properties and applications of the two metals.

AUTHOR: LIU Mingyuan [0491 2494 6678]  
LI Genxiang [2621 2704 4382]

ORG: LIU of Institute of Sericulture, Chinese Academy of Agricultural Sciences  
LI of Jiangsu Provincial Bureau of Agriculture

TITLE: "The Economic Policy of Sericulture is in Need of Adjustment"

SOURCE: Beijing XIANDAIHUA [MODERNIZATION] in Chinese Vol 2, No 4, 16 Apr 80  
p 23

ABSTRACT: Aside from petroleum, silk products have become the single item bringing the highest amount of foreign exchange. China's production of silk was not brought to the highest level in previous history until 1979, however, and the quality of silk products remains much too low. At present, the major problem is the fact the state's purchase price for silk is too low. Last year, the base price for one tan of fresh cocoons was raised 25 percent to 138 yuan, but still not high enough to encourage development of sericulture. In Japan, the price is fixed so that 80 percent of that of silk goes to the farm and 20 percent to the processing industry. If this example is followed, the price should be 167 yuan. The price of silk and cotton should be maintained at a proper ratio. The price of one jin of cocoons should be the equivalent of ten jin of rice, or five jin of cotton. The authors also suggest that just as other economic crops, the state should provide a certain amount of prize grain for the silk cocoons offered by the farmers for the state to purchase.

AUTHOR: HU Yue [5170 2588]

ORG: Third Cooperative Group, Beijing Qigong Research Academy

TITLE: "Treating Disease With Qigong [Air Power] in the 'Eyes' of Modern Science"

SOURCE: Beijing XIANDAIHUA [MODERNIZATION] in Chinese Vol 2, No 4, 16 Apr 80 pp 32-33

ABSTRACT: In clinical observation of a prolonged period of time the authors have noticed that when a Qigong physician proceeds to use his palms and fingers to work on the acupuncture points of the patient, the patient claims to feel heat in the local area, spreading toward the extremities of the body and at the same time some symptoms are also gradually improve. Following the work of GU Hansen [7357 0428 2773] of the Shanghai Institute of Nuclear Research, Chinese Academy of Sciences, the authors used thermograph, infrared thermometer, and a physiological recording instrument to observe surface temperature variations, variations of vascular volume of the fingers, etc. of the Qigong physician during therapy sessions. Measurements of ordinary persons and the same physician in ordinary occasions are used for control. Obvious changes in the amount of heat generated by the physician were recorded by the instruments. Thermograms of the right hand of an ordinary person, of the left hand and the right hand of a Qigong physician before generating his power, 3, 18, and 25 minutes after generating his power for healing are included in the paper.

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CSO: 4009

END

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CHINA REPORT: RED FLAG\*  
CHINA REPORT: Science and Technology

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